

REMARKS

Status of the Claims

Claims 1-34 and 39-42 are pending. Claims 35-38 have been cancelled as being directed to non-elected subject matter pursuant to the restriction requirement dated March 24, 2005 without prejudice to or disclaimer of the subject matter contained therein. Applicants expressly reserve the right to file one or more divisional applications directed to the non-elected subject matter.

Claims 1, 8, 11, 12, 19, 22, 23, 27, 33, 34, and 39 have been amended to even more clearly and distinctly recite the present invention. As amended, claims 1, 8, 12, 19, 23, 27, and 39 are independent. New independent claims 43 and 44 have been added.

Initially, Applicants would like to thank the Examiner for indicating that claims 10, 11, 21, and 22 are directed to allowable subject matter.

Applicants respectfully request the Examiner to reconsider and withdraw the outstanding rejections in view of the foregoing amendments and the following remarks.

Present Claims

Claims 1-22 are directed to an *n*-type diamondoid material and a *p*-type diamondoid material. Claim 1 has been amended to incorporate recitations in claim 10 and now recites "[a]n *n*-type diamondoid material comprising a diamondoid and a metal atom to enhance electrical conductivity, wherein the diamondoid comprises an electron-donating heteroatom." Claim 12 has been amended to incorporate recitations in claim 21 and now recites "[a] *p*-type diamondoid material comprising a diamondoid and a metal atom to enhance electrical conductivity, wherein the diamondoid comprises an electron-withdrawing heteroatom." As such, claims 10 and 21 have been canceled.

Claim 8 has been amended to independent form reciting "[a]n *n*-type diamondoid material comprising a diamondoid, wherein the diamondoid comprises an electron-donating heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane." Similarly, claim 19 has been amended to independent form reciting "[a] *p*-type diamondoid material comprising a diamondoid, wherein the diamondoid comprises an electron-withdrawing heteroatom and is selected from the group consisting of tetramantane,

pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane."

Claims 9 and 20 have been amended to recite the limitation that "the material is a molecular crystal." Claims 11 and 22 have been amended to depend from claims 1 and 12, respectively. Claims 23-42 are directed to an electrical p-n junction and diamondoid transistors. Claim 23 has been amended to recite "[a]n electrical *p-n* junction comprising a *p*-type diamondoid material and an *n*-type diamondoid material, wherein the *n*-type diamondoid material comprises a first diamondoid comprising an electron-donating heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane and wherein the *p*-type diamondoid material comprises a second diamondoid comprising an electron-withdrawing heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane."

Claim 27 has been amended to recite "[a] diamondoid transistor comprising an *n*-type diamondoid material and a *p*-type diamondoid material, wherein the *n*-type diamondoid material comprises a first diamondoid comprising an electron-donating heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane and wherein the *p*-type diamondoid material comprises a second diamondoid comprising an electron-withdrawing heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane."

Claims 33 and 34 have been amended to recite "the *n*-type diamondoid material" and the "*p*-type diamondoid material," respectively. Claim 39 has been amended to recite "[a] diamondoid transistor comprising electrically conducting regions and electrically insulating regions, wherein: the electrically conducting regions of the transistor comprise *n* and *p*-type diamondoid materials, wherein the *n*-type diamondoid material comprises a first diamondoid comprising an electron-donating heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane and wherein the *p*-type diamondoid material comprises a second diamondoid comprising an electron-withdrawing heteroatom and is selected from the

group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane; and the electrically insulating regions of the transistor comprise undoped diamondoid materials."

New claims 43 and 44 are directed to a diamondoid material comprising polymerized diamondoid and a diamondoid material comprising a molecular crystal of diamondoids held together by van der Waals forces, respectively.

Support for such amendments and new claims can be found throughout the instant specification, including in the original claims. Therefore, no new matter has been added.

Claim Rejections under 35 U.S.C. § 102

Claims 1-9 and 12-20 have been rejected under 35 U.S.C. § 102(b) as being anticipated by PCT Patent Application Publication No. WO 88/02792 ("Pastor"). Applicants respectfully disagree with the rejection; therefore, this rejection is respectfully traversed.

Pastor discloses a chemical vapor deposition process for depositing diamond layers. This process utilizes vapor of a hydrocarbon source material in which all of the carbon atoms are saturated and the ratio of hydrogen atoms linked to carbons atoms is less than 2. Additionally, the carbon atoms are tetrahedrally bonded with a bond angle of about 109.5 degrees. A preferred hydrocarbon source material is adamantane. (Abstract). Vapor of a second hydrocarbon source material, which is not a pure hydrocarbon, can also be utilized. (Page 12, lines 23-35). For example, the second hydrocarbon source material can include dopants such as nitrogen, phosphorous, or boron. (Page 12, line 35-page 3, line 3). Using the doped source material along with the pure source material produces diamond layers uniformly doped with the dopant. (Page 7, lines 8-14).

As stated above, claims 1, 8, 12, and 19 are independent. Claim 1 recites an *n*-type diamondoid material comprising a diamondoid and a metal atom to enhance electrical conductivity, wherein the diamondoid comprises an electron-donating heteroatom. Claim 8 recites an *n*-type diamondoid material comprising a diamondoid, wherein the diamondoid comprises an electron-donating heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane. Claim 12 recites a *p*-type diamondoid material comprising a diamondoid and a metal atom to enhance electrical conductivity, wherein the diamondoid comprises an electron-withdrawing heteroatom. Claim 19 recites a *p*-type

diamondoid material comprising a diamondoid, wherein the diamondoid comprises an electron-withdrawing heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane.

Pastor fails to disclose or suggest all of the elements of claims 1 and 12. Specifically, claims 1 and 12 require that the diamondoid material comprise a metal atom to enhance electrical conductivity. While the diamond layers deposited in Pastor can include dopant atoms such as boron, phosphorous, or nitrogen, these dopant atoms are nonmetallic. As such, the diamond layers of Pastor do not include a metal atom. Accordingly, for at least the above reasons, Pastor does not anticipate claims 1 and 12.

Pastor also fails to disclose or suggest all of the elements of claim 8 and 19. Specifically, claims 8 and 19 require that the diamondoid is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane. In contrast, Pastor only discloses incorporating adamantane into the deposited diamond layers. Applicants respectively submit that higher diamondoids like tetramantane, pentamantane, etc. are significantly different from adamantane.

Adamantane is the smallest member of the diamondoid series consisting of only a single cage crystalline subunit. Higher diamondoids are composed of multiple cage subunits. For example, tetramantane is made of four cage subunits, pentamantane is made of five cage subunits, hexamantane is made of six cage subunits, and so on. (Page 13, lines 21-23).

Higher diamondoids have more isomers per family. Adamantane exists in only one isomeric form and higher diamondoids have multiple isomeric forms. There are four different isomeric forms of tetramantane and the number of possible isomers increases non-linearly with each higher member of the diamondoid series, pentamantane, hexamantane, etc. (Page 13, lines 23-28).

Higher diamondoids also exhibit chirality. For example, the four isomeric forms of tetramantane include an enantiomeric pair. (Page 13, lines 23-26).

Higher diamondoids can have multiple molecular weight classes per family. In contrast, adamantane only has one molecular weight. By way of example, pentamantane has two molecular weight classes; hexamantane has three molecular weight classes;

heptamantane has four molecular weight classes; octamantane has five molecular weight classes; nonamantane has six molecular weight classes; decamantane has seven molecular weight classes; and undecamantane has eight molecular weight classes. (Page 14, line 22-page 15, line 31).

Higher diamondoids also differ from adamantane because most higher diamondoids cannot be synthesized. Adamantane has been successfully synthesized and is even commercially available. (Page 13, line 29-page 14, line 5). However, to the Applicants' knowledge, tetramantane is the only higher diamondoid that has been synthesized to date. (Page 14, lines 6-11).

Additionally, Applicants respectfully submit that adamantane differs from higher diamondoids in the following respects: whether or not they can be distilled at atmospheric pressure; whether or not they can be isolated by distillation alone, and what other types of materials are co-distilled in any particular distillate cut; and whether or not all members of the family readily crystallize.

Moreover, the diamondoids of claims 8 and 19 are heterodiamondoids because they include electron-donating and electron-withdrawing heteroatoms, respectively. Heteroadamantane has been reported in the literature, but, to the Applicants' knowledge, no higher heterodiamondoids had been synthesized. (Page 16, lines 12-14). As such, as higher heterodiamondoids were not in existence when Pastor's process was invented or published.

Accordingly, for at least the above reasons, Applicants respectfully submit that claims 8 and 19 are patentable over Pastor.

Applicants further maintain that Pastor teaches away from the use of higher diamondoids. Pastor states "increasing the atom mass of a molecule ordinarily decreases its vapor pressure, so that it becomes increasingly difficult to introduce a sufficient amount of the vapor into the carrier gas stream to attain high deposition rates of the layer 12." (Page 14, lines 25-30). Higher diamondoids have greater atomic mass than adamantane and increase in atomic mass as they increase in complexity. Consequently, higher diamondoids are harder to vaporize than adamantane and, according to Pastor, would not be desirable.

Applicants respectfully submit that new claim 43 is patentable over Pastor. New claim 43 is directed to a diamondoid material comprising polymerized diamondoids, wherein each diamondoid comprises at least one electron-donating heteroatom or at least one electron-

withdrawing heteroatom and further wherein the diamondoids are selected from the group consisting of diamantane, triamantane, tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane. Applicants respectively submit that Pastor does not disclose or suggest polymerized diamondoids.

Pastor only discloses chemical vapor deposition of adamantane to form diamond layers. Chemical vapor deposition is significantly different from polymerization. During Pastor's chemical vapor deposition, hydrogen atoms are stripped from an adamantane molecule and the remainder of the molecule, namely carbon atoms, are deposited without any carbon-carbon bond breakage to form a diamond layer. (Page 8, lines 15-20).

In contrast, polymerization includes various reaction pathways, including addition polymerization wherein double or triple bonds in unsaturated monomers break linking the monomers together, condensation polymerization wherein monomers bond through condensation reactions releasing water, and reaction between functional groups of monomers. These types of reactions do not take place during Pastor's chemical vapor deposition. First, adamantane is a saturated molecule. Second, Pastor states that the source materials are formed only of hydrogen, carbon and optionally dopant atoms. The source materials do not include other atoms or functional groups. In fact, the formation of water poisons the deposition. (Page 6, lines 26-37).

Moreover, even if Pastor disclosed polymerization, Pastor only utilizes adamantane. As described above, adamantane is significantly different than higher diamondoids such as tetramantane, pentamantane, etc. Adamantane is also distinct from diamantane and triamantane. Diamantane and triamantane are more complex molecules than adamantane. They have two and three cage subunits, respectively, while adamantane only has one cage subunit. Their respective molecular weights are also greater than the molecular weight of adamantane. Also, as discussed above, Applicants respectfully submit that Pastor teaches away from the use of more complex diamondoids. For at least the above reasons, new claim 43 is patentable over Pastor.

Applicants respectfully submit that new claim 44 is also patentable over Pastor. New claim 44 is directed to a diamondoid material comprising a molecular crystal of diamondoids held together by van der Waals forces wherein each diamondoid comprises at least one electron-donating heteroatom or at least one electron-withdrawing heteroatom and further

wherein the diamondoids are selected from the group consisting of adamantane, diamantane, triamantane, tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane. Applicants respectively submit that Pastor does not disclose or suggest a molecular crystal of diamondoids.

As set forth in the specification and claim 44, the molecular crystal is held together by van der Waals forces. No functionalization is necessary to polymerize or link up individual diamondoid molecules and no expensive deposition equipment is needed because van der Waals forces are sufficient. (Page 35, lines 10-15). Van der Waals forces involve momentary attraction between molecules caused by momentary polarization. In contrast, Pastor involves deposition whereby the deposited molecules are chemically bonded by carbon-carbon covalent bonds. For at least the above reasons, new claim 44 is patentable over Pastor.

Claim Rejections under 35 U.S.C. § 103

Claims 23-34 stand rejected under 35 U.S.C. § 103(a) as being obvious over Pastor in view of U.S. Patent 5,057,894 ("Ikeda et al."). Applicants respectfully disagree with the rejection; therefore, this rejection is respectfully traversed.

As described above, Pastor discloses a chemical vapor deposition process for depositing diamond layers in which a preferred hydrocarbon source material is adamantane. (Abstract).

Ikeda et al. discloses a semiconductor integrated circuit device including an n-channel MISFET (Metal-Insulator Semiconductor Field Effect Transistor) and a p-channel MISFET. (Abstract). Figure 13 depicts both the n-channel MISFET having an n-p-n structure and a p-channel MISFET having a p-n-p structure. The n-channel MISFET is made of a p-type well region 600, n-type semiconductor regions 1400, and n+-type semiconductor regions 1700. The semiconductor regions 1400, 1700 constitute a source and drain. (Col. 12, lines 21-27). The p-channel MISFET is made of an n-type well region 500, p-type semiconductor regions 1500, and p+-type semiconductor regions 1800. The semiconductor regions 1500, 1800 constitute a source and drain. (Col. 13, lines 8-14).

Independent claim 23 recites an electrical *p-n* junction comprising a *p*-type diamondoid material and an *n*-type diamondoid material, wherein the *n*-type diamondoid material comprises a first diamondoid comprising an electron-donating heteroatom and is

selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane and wherein the *p*-type diamondoid material comprises a second diamondoid comprising an electron-withdrawing heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane.

Independent claim 27 recites a diamondoid transistor comprising an *n*-type diamondoid material and a *p*-type diamondoid material, wherein the *n*-type diamondoid material comprises a first diamondoid comprising an electron-donating heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane and wherein the *p*-type diamondoid material comprises a second diamondoid comprising an electron-withdrawing heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane.

Applicants respectfully submit that neither Pastor nor Ikeda et al. disclose or suggest at least the following elements of claims 23 and 27: (1) an *n*-type diamondoid material, wherein the *n*-type diamondoid material comprises a first diamondoid comprising an electron-donating heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane and (2) a *p*-type diamondoid material, wherein the *p*-type diamondoid material comprising a second diamondoid comprising an electron-withdrawing heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane.

As described above, Pastor does not disclose or suggest a diamondoid material wherein the diamondoids are higher diamondoids. Pastor merely discloses a diamond film formed from adamantane and doped adamantane. As described above, adamantane is significantly different than higher diamondoids and Pastor teaches away from the deposition of higher diamondoids. Ikeda et al. discusses transistors in a semiconductor integrated circuit device. Accordingly, Applicants respectfully submit that Ikeda et al. fails to correct the many deficiencies of Pastor. Accordingly, Pastor and Ikeda, even if combined, do not disclose or suggest the presently

claimed electrical *p-n* junction of claim 23 or the presently claimed diamondoid transistor of claim 27.

For at least the above-noted reasons, Applicants respectfully request that this rejection under 35 U.S.C. § 103(a) be withdrawn.

Claims 39-42 stand rejected under 35 U.S.C. § 103(a) as being obvious over Pastor in view of Ikeda et al. and further in view of U.S. Patent Application Publication 2002/0016414 ("Lau et al."). Applicants respectfully disagree with the rejection; therefore, this rejection is respectfully traversed.

As described above, Pastor discloses a chemical vapor deposition process for depositing diamond layers in which a preferred hydrocarbon source material is adamantane. (Abstract).

As described above, Ikeda et al. discloses a semiconductor integrated circuit device including an n-channel MISFET (Metal-Insulator Semiconductor Field Effect Transistor) and a p-channel MISFET.

Lau et al. discloses low dielectric constant materials having a first backbone with an aromatic moiety and a first reactive group, a second backbone with an aromatic moiety and a second reactive group, and a cage structure having at least 10 atoms covalently bound to at least one of the backbones. The first and second reactive groups crosslink the first and second backbones. (Page 2, paragraph [0011]). The cage structure can be adamantane, substituted or unsubstituted, or diamantane, substituted or unsubstituted. (Page 2, paragraph [0013]).

Independent claim 39 recites a diamondoid transistor comprising electrically conducting regions and electrically insulating regions, wherein: the electrically conducting regions of the transistor comprise *n* and *p*-type diamondoid materials, wherein the *n*-type diamondoid material comprises a first diamondoid comprising an electron-donating heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane and wherein the *p*-type diamondoid material comprises a second diamondoid comprising an electron-withdrawing heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and

undecamantane; and the electrically insulating regions of the transistor comprise undoped diamondoid materials.

Applicants respectfully submit that none of Pastor, Ikeda et al., and Lau et al. disclose or suggest at least the following elements of claim 39: (1) an n-type diamondoid material, wherein the n-type diamondoid material comprises a first diamondoid comprising an electron-donating heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane and (2) a p-type diamondoid material, wherein the p-type diamondoid material comprising a second diamondoid comprising an electron-withdrawing heteroatom and is selected from the group consisting of tetramantane, pentamantane, hexamantane, heptamantane, octamantane, nonamantane, decamantane, and undecamantane.

As described above, Pastor does not disclose or suggest a diamondoid material wherein the diamondoids are higher diamondoids. Pastor merely discloses a diamond film formed from adamantane and doped adamantane. As described above, adamantane is significantly different than higher diamondoids and Pastor teaches away from the deposition of higher diamondoids. Ikeda et al. discusses transistors in a semiconductor integrated circuit device. Lau et al. describes low dielectric constant materials having adamantane or diamantane as a functional group. Accordingly, Applicants respectfully submit that Ikeda et al. and Lau et al. fail to correct the many deficiencies of Pastor. Accordingly, Pastor, Ikeda, and Lau, even if combined, do not disclose or suggest the presently claimed diamondoid transistor of claim 39.

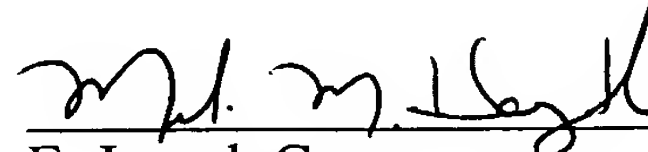
For at least the above-noted reasons, Applicants respectfully request that this rejection under 35 U.S.C. § 103(a) be withdrawn.

Respectfully submitted,

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